

The Influence of Exercise on Mental Health

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HIGHLIGHT

“We now have evidence to support the claim that exercise is related to positive mental health as indicated by relief in symptoms of depression and anxiety.”

A NOTE FROM THE EDITORS

Mental health as discussed in this paper by Dr. Daniel Landers, a leading authority on this topic, focuses on conditions sometimes considered to be illness states (i.e., pathological depression) as well as conditions that limit wellness or quality of life (i.e., anxiety, low self-esteem). To aid the reader, some basic terms used in this paper are outlined in the boxes below.

Definitions

Acute. Acute refers to something that occurs at a specific time often for a relatively short duration. For example, acute exercise refers to a bout of exercise done at a specific time for a specific amount of time. Acute anxiety is anxiety that exists in a person in response to a specific event (same as state anxiety).

Anxiety. Anxiety is a form of negative self-appraisal characterized by worry, self-doubt, and apprehension.

Chronic. Chronic refers to something that persists for a relatively long period of time. Chronic depression, for example, would be depression that lasts a long time. A chronic exerciser is someone who does exercise on a regular basis.

Depression. Depression is a state of being associated with feelings of hopelessness or a sense of defeat. People with depression often feel “down” or “blue” even when circumstances would dictate otherwise. All people feel “depressed” at times, but a “depressed” person feels this way much of the time.

Clinical depression. This is depression (see definition) that persists for a relatively long period of time or becomes so severe that a person needs special help to cope with day-to-day affairs.

Meta-analysis. A type of statistical analysis that researchers use to make sense of many different research studies done on the same topic. By analyzing findings from many different studies, conclusions can be drawn concerning the results of all studies considered together. Both unpublished and published studies can be included in this type of analysis.

Positive mood. Positive self-assessments associated with feelings of vigor, happiness, and/or other positive feelings of well-being.

State anxiety. State anxiety is anxiety present in very specific situations. For example, state sports anxiety is present when a person is anxious in a specific sports situation even if the person is not generally anxious.

Trait anxiety. Trait anxiety is the level of anxiety present in a person on a regular basis. A person with high trait anxiety is anxious much of the time while a person low in trait anxiety tends to be anxious less often and in fewer situations.

Mental Health Benefits of Physical Activity

Reduced anxiety

- Best results with “aerobic exercise”
- Best after weeks of regular exercise
- Best benefits to those who are low fit to begin with
- Best benefits for those high in anxiety to begin with

Reduced depression

- Best after weeks of regular exercise
- Best when done several times a week
- Best with more vigorous exercise
- Best for those who are more depressed (needs more research)

Benefits (anxiety and depression) similar to those for other treatments

Activity associated with positive self-esteem

Activity associated with restful sleep

Activity associated with ability to respond to stress

For some time now, it has been common knowledge that exercise is good for one's physical health. It has only been in recent years, however, that it has become commonplace to read in magazines and health newsletters that exercise can also be of value in promoting sound mental health. Although this optimistic appraisal has attracted a great deal of attention, the scientific community has been much more cautious in offering such a blanket endorsement. Consider the tentative conclusions from the Surgeon General's Report on Physical Activity and Health (*PCPFS Research Digest*, 1996) that “physical activity appears to relieve symptoms of depression and anxiety and improve mood” and that “regular physical activity may reduce the risk of developing depression, although further research is needed on this topic.”

The use of carefully chosen words, such as “appears to” and “may” illustrate the caution that people in the scientific community have when it comes to claiming mental health benefits derived from exercise. Part of the problem in interpreting the scientific literature is that there are over 100 scientific studies dealing with exercise and depression or exercise and anxiety and not all of these studies show statistically significant benefits with exercise training. The paucity of clinical trial studies and the fact that a “mixed bag” of significant and nonsignificant findings exists makes it difficult for scientists to give a strong endorsement for the positive influence of exercise on mental health. There is no doubt that the mental health area needs more clinical trial studies. This would be particularly useful in determining if exercise “causes” improvements in variables associated with sound mental health. However, until these clinical trial studies materialize, there is still much that can be done to strengthen statements made about exercise and mental health.

What evidence would prompt some scientists to “stick their necks out” in favor of more definitive statements? One reason for greater optimism is the recent appearance of quantitative reviews (i.e., meta-analyses) of the literature on a number of mental health topics. These reviews differ in several ways from the traditional narrative reviews. A meta-analysis allows for a summary of results across studies. By including all published and unpublished studies and combining their results, statistical power is increased. Another advantage of using this type of review process is that a clearly defined sequence of steps is followed and included in the final report so that anyone can replicate the studies. Two additional advantages that meta-analysis has over other types of reviews include: (a) the use of a quantification technique that gives an objective estimate of the magnitude of the exercise treatment effect; and (b) its ability to examine potential moderating variables to determine if they influence exercise-mental health relationships. Given these advantages, this paper will focus primarily on results derived from large-scale meta-analytic reviews.

ANXIETY REDUCTION FOLLOWING EXERCISE

It is estimated that in the United States approximately 7.3% of the adult population has an anxiety disorder that necessitates some form of treatment (Regier et al., 1988). In addition, stress-related emotions, such as anxiety, are common among healthy individuals (Cohen, Tyrell, & Smith, 1991). The current interest in prevention has heightened interest in exercise as an alternative or adjunct to traditional interventions such as psychotherapy or drug therapies.

Anxiety is associated with the emergence of a negative form of cognitive appraisal typified by worry, self-doubt, and apprehension. According to Lazarus and Cohen (1977), it usually arises “...in the face of *demands that tax or exceed the resources of the system* or ... demands to which there are no readily available or automatic adaptive responses” (p. 109). Anxiety is a cognitive phenomenon and is usually measured by questionnaire instruments. These questionnaires are sometimes accompanied by physiological measures that are associated with heightened arousal/anxiety (e.g., heart rate, blood pressure, skin conductance, muscle tension). A common distinction in this literature is between state and trait questionnaire measures of anxiety. Trait anxiety is the general predisposition to respond across many situations with high levels of anxiety. State anxiety, on the other hand, is much more specific and refers to the person’s anxiety at a particular moment. Although “trait” and “state” aspects of anxiety are conceptually distinct, the available operational measures show a considerable amount of overlap among these subcomponents of anxiety (Smith, 1989).

For meta-analytic reviews of this topic, the inclusion criterion has been that only studies examining anxiety measures before and after either acute or chronic exercise have been included in the review. Studies with experiment-imposed psychosocial stressors during the postexercise period have not been included since this would confound the effects of exercise with the effects of stressors (e.g., Stoop color-word test, active physical performance). The meta-analysis by Schlicht (1994), however, included some stress-reactivity studies and therefore was not interpretable.

Landers and Petruzzello (1994) examined the results of 27 narrative reviews that had been conducted between 1960 and 1991 and found that in 81% of them the authors had concluded that physical activity/fitness was related to anxiety reduction following exercise and there was little or no conflicting data presented in these reviews. For the other 19%, the authors had concluded that most of the findings were supportive of exercise being related to a reduction in anxiety, but there were some divergent results. None of these narrative reviews concluded that there was no relationship.

There have been six meta-analyses examining the relationship between exercise and anxiety reduction (Calfas & Taylor, 1994; Kugler, Seelback, & Kruskemper, 1994; Landers & Petruzzello, 1994; Long & van Stavel, 1995; McDonald & Hodgdon, 1991; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991). These meta-analyses ranged from 159 studies (Landers & Petruzzello, 1994; Petruzzello et al., 1991) to five studies (Calfas & Taylor, 1994) reviewed. All six of these meta-analyses found that across all studies examined, exercise was significantly related to a reduction in anxiety. These effects ranged from “small” to “moderate” in size and were consistent for trait, state, and psychophysiological measures of anxiety. The vast majority of the narrative reviews and all of the meta-analytic reviews support the conclusion that across studies published between 1960 and 1995 there is a small to moderate relationship showing that both acute and chronic exercise reduces anxiety. This reduction occurs for all types of subjects, regardless of the measures of anxiety being employed (i.e., state, trait or psychophysiological), the intensity or the duration of the exercise, the type of exercise paradigm (i.e., acute or chronic), and the scientific quality of the studies. Another meta-analysis (Kelley & Tran, 1995) of 35 clinical trial studies involving 1,076 subjects has confirmed the psychophysiological findings in showing small ($-4/-3$ mm Hg), but statistically significant, postexercise reductions for both systolic and diastolic blood pressure among normal normotensive adults.

In addition to these general effects, some of these meta-analyses (Landers & Petruzzello, 1994; Petruzzello et al., 1991) that examined more studies and therefore had more findings to consider were able to identify several variables that moderated the relationship between exercise and anxiety reduction. Compared to the overall conclusion noted above, which is based on hundreds of studies involving thousands of subjects, the findings for the moderating variables are based on a much smaller database. More research, therefore, is warranted to examine further the conclusions derived from the following moderating variables. The meta-analyses show that the larger effects of exercise on anxiety reduction are shown when: (a) the exercise is “aerobic” (e.g., running, swimming, cycling) as opposed to nonaerobic (e.g., handball, strength-flexibility training), (b) the length of the aerobic training program is at least 10 weeks and preferably greater than 15 weeks, and (c) subjects have initially lower levels of fitness or higher levels of anxiety. The “higher levels of anxiety” includes coronary (Kugler et al., 1994) and panic disorder patients (Meyer, Broocks, Hillmer-Vogel, Bandelow, & Rüther, 1997). In addition, there is limited evidence which suggests that the anxiety reduction is not an artifact “due more to the cessation of a potentially threatening activity than to the exercise itself” (Petruzzello, 1995, p. 109), and the time course for postexercise anxiety reduction is somewhere between four to six hours before anxiety returns to pre-exercise levels (Landers & Petruzzello, 1994). It also appears that although exercise differs from no treatment control groups, it is usually not shown to differ from other known anxiety-reducing treatments (e.g., relaxation training). The finding that exercise can produce an anxiety reduction similar in magnitude to other commonly employed anxiety treatments is noteworthy since exercise can be considered at least as good as these techniques, but in addition, it has many other physical benefits.

EXERCISE AND DEPRESSION

Depression is a prevalent problem in today’s society. Clinical depression affects 2–5% of Americans each year (Kessler et al., 1994) and it is estimated that patients suffering from clinical depression make up 6–8% of general medical practices (Katon & Schulberg, 1992). Depression is also costly to the health care system in that depressed individuals annually spend 1.5 times more on health care than nondepressed individuals, and those being treated with antidepressants spend three times more on outpatient pharmacy costs than those not on drug therapy (Simon, VonKorff, & Barlow, 1995). These costs have led to increased governmental pressure to reduce health care costs in America. If available and effective, alternative low-cost therapies that do not have negative side effects need to be incorporated into treatment plans. Exercise has been proposed as an alternative or adjunct to more traditional approaches for treating depression (Hales & Travis, 1987; Martinsen, 1987, 1990).

The research on exercise and depression has a long history of investigators (Franz & Hamilton, 1905; Vaux, 1926) suggesting a relationship between exercise and decreased depression. Since the early 1900s, there have been over 100 studies examining this relationship, and many narrative reviews on this topic have also been conducted. During the 1990s there have been at least five meta-analytic reviews (Craft, 1997; Calfas & Taylor, 1994; Kugler et al., 1994; McDonald & Hodgdon, 1991; North, McCullagh, & Tran, 1990) that have examined studies ranging from as few as nine (Calfas & Taylor, 1994) to as many as 80 (North et al., 1990). Across these five meta-analytic reviews, the results consistently show that both acute and chronic exercise are related to a significant reduction in depression. These effects are generally “moderate” in magnitude (i.e., larger than the anxiety-reducing effects noted earlier) and occur for subjects who were classified as nondepressed, clinically depressed, or mentally ill. The findings indicate that the antidepressant effect of exercise begins as early as the first session of exercise and persists beyond the end of the exercise program (Craft, 1997; North et al., 1990). These effects are also consistent across age, gender, exercise group size, and type of depression inventory.

Exercise was shown to produce larger antidepressant effects when: (a) the exercise training program was longer than nine weeks and involved more sessions (Craft, 1997; North et al., 1990); (b) exercise was of longer duration, higher intensity, and performed a greater number of days per week (Craft, 1997); and (c) subjects were classified as medical rehabilitation patients (North et al., 1991) and, based on questionnaire instruments, were classified as moderately/severely depressed compared to mildly/moderately depressed (Craft, 1997). The latter effect is limited since only one study used individuals who were classified as severely depressed and only two studies used individuals who were classified as moderately to severely depressed. Although limited at this time, this finding calls into question the conclusions of several narrative reviews (Gleser & Mendelberg, 1990; Martinsen, 1987, 1993, 1994), which indicate that exercise has antidepressant effects only for those who are initially mild to moderately depressed.

The meta-analyses are inconsistent when comparing exercise to the more traditional treatments for depression, such as psychotherapy and behavioral interventions (e.g., relaxation, meditation), and this may be related to the types of subjects employed. In examining all types of subjects, North et al. (1990) found that exercise decreased depression more than relaxation training or engaging in enjoyable activities, but did not produce effects that were different from psychotherapy. Craft (1997), using only clinically depressed subjects, found that exercise produced the same effects as psychotherapy, behavioral interventions, and social contact. Exercise used in combination with individual psychotherapy or exercise together with drug therapy produced the largest effects; however, these effects were not significantly different from the effect produced by exercise alone (Craft, 1997).

That exercise is at least as effective as more traditional therapies is encouraging, especially considering the time and cost involved with treatments like psychotherapy. Exercise may be a positive adjunct for the treatment of depression since exercise provides additional health benefits (e.g., increase in muscle tone and decreased incidence of heart disease and obesity) that behavioral interventions do not. Thus, since exercise is cost effective, has positive health benefits, and is effective in alleviating depression, it is a viable adjunct or alternative to many of the more traditional therapies. Future research also needs to examine the possibility of systematically lowering antidepressant medication dosages while concurrently supplementing treatment with exercise.

OTHER VARIABLES ASSOCIATED WITH MENTAL HEALTH

Positive mood. The Surgeon General's Report also mentions the possibility of exercise improving mood. Unfortunately the area of increased positive mood as a result of acute and chronic exercise has only recently been investigated and therefore there are no meta-analytic reviews in this area. Many investigators are currently examining this subject and many of the preliminary results have been encouraging. It remains to be seen if the additive effects of these studies will result in conclusions that are as encouraging as the relationship between exercise and the alleviation of negative mood states like anxiety and depression.

Self-esteem. Related to the area of positive mood states is the area of physical activity and self-esteem. Although narrative reviews exist in the area of physical activity and enhancement of self-esteem, there are currently four meta-analytic reviews on this topic (Calfas & Taylor, 1994; Gruber, 1986; McDonald & Hodgdon, 1991; Spence, Poon, & Dyck, 1997). The number of studies in these meta-analyses ranged from 10 studies (Calfas & Taylor, 1994) to 51 studies (Spence et al., 1997). All four of the reviews found that physical activity/exercise brought about small, but statistically significant, increases in physical self-concept or self-esteem. These effects generalized across gender and age groups. In comparing self-esteem scores in children, Gruber (1986) found that aerobic fitness produced much larger effects on self-esteem scores than other types of physical education class activities (e.g., learning sports skills or perceptual-motor skills). Gruber (1986) also found that the effect of physical activity was larger for handicapped compared to nonhandicapped children.

Restful sleep. Another area associated with positive mental health is the relationship between exercise and restful sleep. Two meta-analyses have been conducted on this topic (Kubitz, Landers, Petruzzello, & Han, 1996; O'Connor & Youngstedt, 1995). The studies reviewed have primarily examined sleep duration and total sleep time as well as measures derived from electroencephalographic (EEG) activity while subjects are in various stages of sleep. Operationally, sleep researchers have predicted that sleep duration, total sleep time, and the amount of high amplitude, slow wave EEG activity would be higher in physically fit individuals than those who are unfit (i.e., chronic effect) and higher on nights following exercise (i.e., acute effect). This prediction is based on the "compensatory" position, which posits that "fatiguing daytime activity (e.g., exercise) would probably result in a compensatory increase in the need for and depth of nighttime sleep, thereby facilitating recuperative, restorative and/or energy conservation processes" (Kubitz et al., p. 278).

The sleep meta-analyses by O'Connor and Youngstedt (1995) and Kubitz et al. (1996) show support for this prediction. Both reviews show that exercise significantly increases total sleep time and aerobic exercise decreases rapid eye movement (REM) sleep. REM sleep is a paradoxical form in that it is a deep sleep, but it is not as restful as slow wave sleep (i.e., stages 3 and 4 sleep). Kubitz et al. (1996) found that acute and chronic exercise was related to an increase in slow wave sleep and total sleep time, but was also related to a decrease in sleep onset latency and REM sleep. These findings support the compensatory position in that trained subjects and those engaging in an acute bout of exercise went to sleep more quickly, slept longer, and had a more restful sleep than untrained subjects or subjects who did not exercise. There were moderating variables influencing these results. Exercise had the biggest impact on sleep when: (a) the individuals were female, low fit, or older; (b) the exercise was longer in duration; and (c) the exercise was completed earlier in the day (Kubitz et al., 1996).

SUMMARY

The research literature suggests that for many variables there is now ample evidence that a definite relationship exists between exercise and improved mental health. This is particularly evident in the case of a reduction of anxiety and depression. For these topics, there is now considerable evidence derived from over hundreds of studies with thousands of subjects to support the claim that “exercise is related to a relief in symptoms of depression and anxiety.” Obviously, more research is needed to determine if this overall relationship is “causal,” and there is also a need to examine further some of the variables that are believed to moderate the overall relationship.

For many of the other variables related to mental health, the initial meta-analyses have shown evidence that is promising. Compared to the area of depression and anxiety, however, there is either a need for more research on these topics or more quantitative reviews of the expansive research that already exists. For example, the relatively new research into the influence of exercise on positive mood states is in need of more research studies, whereas the area of exercise and self-esteem needs quantitative reviews of the expansive research literature that already exists. At the present time, it appears that aerobic exercise enhances physical self-concept and self-esteem, but more research needs to be done to confirm these initial findings. Exercise is related not only to a relief in symptoms of depression and anxiety but it also seems to be beneficial in enhancing self-esteem, producing more restful sleep, and helping people recover more quickly from psychosocial stressors. None of these relationships is the result of a single study. They are based on most, if not all, of the available research in the English language at the time the meta-analytic review was published. The overall positive patterns of the meta-analytic findings for these variables lends greater confidence that exercise has an important role to play in promoting sound mental health.

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